Thermal Analysis of NPSAT1 Battery

Introduction

NPSAT1 is a low-cost, technology demonstration satellite hosting a number of experiments. Commercial, off-the-shelf (COTS)-based technology will be implemented with custom designs to offer a low-cost command and data handling (C&DH) subsystem building on commercial, desktop PC architecture and standards-based specifications.   In addition to an experimental C&DH subsystem, NPSAT1 will demonstrate the use of non-volatile ferroelectric RAM which is inherently radiation-tolerant and lithium-ion polymer batteries, state-of-the-art technology that will be employed offering high energy density (Watt-hr/kg) for space applications.

Experiments on-board NPSAT1 include two Naval Research Laboratory (NRL) payloads. The coherent electromagnetic radio tomography (CERTO) experiment and a Langmuir probe. The CERTO experiment is a radio beacon which, in concert with ground station receivers, is used to measure total-electron-content (TEC) in the ionosphere. The Langmuir probe will augment CERTO data by providing on-orbit measurements. The other experiments are of NPS origin. These include a novel design for a spacecraft computer board, a COTS visual imager (VISIM), and some micro-electromechanical systems (MEMS)-based rate sensors.

Description of Thesis Topic

A thermal model is needed for the NPSAT1 spacecraft assembly which will assess the thermal properties of surfaces and interfaces, operation of heaters, and an estimate of the duty cycles of such heaters. A finite element analysis (FEA) model is to be generated and iterative analyses performed to gage the thermal environment of the spacecraft subsystems and critical components, specifically, the batteries. The IDEAS software tool, must be used which will require some amount of learning.

Proposed Outline
- NPSAT1 Introduction
- Spacecraft Configuration
- Space Thermal Environment
- Overview of Thermal Analysis and Modeling
- NPSAT1 Thermal Model
- Thermal Analysis Results
- Conclusions & Recommendations

Suggested References
- *Satellite Thermal Control Handbook,* D. W. Gilmore, Aerospace Corp., 1994.
- *IDEAS Master Series Student Guide,* SDRC, Milford, OH, 1994